SACHS'S "TEXT-BOOK OF BOTANY"

Text-book of Botany, Morphological and Physiological. By Julius Sachs, Professor of Botany in the University of Würzburg. Translated and annotated by Alfred W. Bennett, M.A., B.Sc., F.L.S., assisted by W. T. Thiselton Dyer, M.A., B.Sc., F.L.S. (Oxford: at the Clarendon Press, 1875.)

IN 1868 the first edition of Dr. Sachs's "Lehrbuch der Botanik" appeared in Germany; a second edition was soon called for, and it appeared in 1870; the third was published in 1873, and the fourth was issued about the end of 1874. The third edition was translated into French and annotated by M. Ph. van Tieghem, and now we have an English translation of the same edition from the hands of Messrs. Bennett and Dyer.

The want of a good text-book of Botany, one that would give an accurate idea of the present state of botanical science, has long been felt by English students. We therefore heartily welcome the appearance of the English translation of Sachs's "Lehrbuch der Botanik," because we feel certain that it will supply that want so long felt, and be of the greatest value to both teachers and students. Our text-books had mostly fallen behind the time, the older ideas and theories were still retained instead of being swept away to make room for new facts or for the more correct interpretation of long-known but imperfectly understood phenomena. The illustrations of the older works were often defective, frequently absolutely incorrect, and yet they descended from text-book to text-book with unfailing regularity. Terms were multiplied needlessly, without any correct appreciation of the facts to be indicated by them; lectures became a mere illustrated botanical glossary, the biology and physiology of plants were almost entirely neglected, and the science rendered as repulsive as possible. In the work now before us we have a text-book of Botany which the teacher can confidently recommend to the student as being an excellent guide; as giving an extensive and trustworthy account of the present state of botanical science in Europe; and while it indicates the theories and problems at present occupying the attention of botanists, it points him to the subjects which will best repay the original investigator. The illustrations form an important feature in the work, most of them being original, and the result of laborious investigation: if borrowed, it was only when the objects were inacessible, or because it seemed impossible to give a better than the figure already in use. This gives a freshness to the book, which is a charm in a text-book of Botany.

Prof. Sachs's work is devoted exclusively to Morphological and Physiological Botany, and therefore differs in its scope from the text-books to which botanical students in this country are accustomed. The whole work is divided into three books. Books I. and II. treat respectively of General and Special Morphology, Book III. being devoted to Physiology. No exhaustive account of the characters of the natural orders of flowering plants is given, a feature which at once places Sachs's text-book in marked contrast to our English ones. All that is given is an enumeration of the orders and families according to the systems recently proposed by Braun and Hanstein. But the want of characters of orders and families cannot be felt by the English student, as he can consult the admirable translation of Le Maout and Decaisne's "Traité Général de Botanique," and there get all he can possibly want. Indeed, we may look upon Sachs and Le Maout and Decaisne as forming a complete work, the one treating fully of such parts of botany as are omitted or only very imperfectly dwelt upon by the other.

The General Morphology of Plants is treated of by Sachs in the three chapters forming the first book. The first chapter deals entirely with the morphology of the cell, and is a most exhaustive treatise on the subject. In describing the nature of the cell, Sachs says: "By far the largest proportion of cells in the living succulent parts of plants, *e.g.* young roots, leaves, internodes, fruits, are seen to be made up of three concentrically-disposed layers; firstly, an outer skin, firm and elastic, the cell-membrane or cell-wall, consisting of a substance peculiar to itself, which we call cellulose. Close up to the inner side of this entirely closed membrane is a second layer, also entirely closed, the substance of which is soft and inelastic, and always contains albuminous matter; H. von Mohl, who first discovered this substance, gave it the very distinctive appellation of Protoplasm. In the condition of cells now under consideration it forms a sac enclosed by the cell-wall, in which usually also other portions of protoplasm are present in the form of plates and threads. Absent from some of the lowest organisms, but present in all the higher plants without exception, there lies imbedded in the protoplasm a roundish body, the substance of which is very similar to that of the protoplasm—the nucleus. The cavity enclosed by the protoplasm sac is filled with a watery fluid, the cell-sap. And besides this, there are also very commonly found in the interior of the cell granular bodies, which, however, may be passed over for the moment." Following this we have an account of the formation of cells, and then the cell-wall, the protoplasm, nucleus, granular and other substances contained in the protoplasm, cell-sap and crystals are each described in turn. The union of cells to form tissues is next described, and Sachs gives us a three-fold division of tissues into epidermal, fibro-vascular, and fundamental or "ground tissue." The section devoted to Primary Meristem and the apical cell will be read with interest, and the facts there stated will probably be new to most English readers.

The Morphology of the External Conformation of Plants is treated of in the last chapter of the first book. In English text-books much space is devoted to "Organography," the physiological method of study being chiefly adopted. Sachs, however, draws a wide distinction between members and organs, and in the section on Metamorphosis shows that all "organs" may be referred to a few original forms. The original forms or morphological members are only five in number, viz., Thallome, Caulome, Phyllome, Trichome, and Root. These members do not perform any functions, but they are capable of being "adapted" or metamorphosed into "organs" performing many very different functions. Take the adaptations of a Phyllome or leaf-member as an illustration of this. Sachs mentions that "the thick scales of a bulb, the skin-like (not "cuticular," as given in the English translation, p. 129, top line) appendages of many tubers, the parts of the calyx and corolla, the stamens and

carpels, many tendrils and prickles, &c., are altogether similar (in mode of development) to the green organs which have been termed simply leaves." So with all the other members; they may be modified to perform the most varied functions.

The second book, treating of Special Morphology and outlines of Classification, will probably be found to be the most generally interesting part of the work. It gives a clear and valuable account of all the "classes" of the vegetable kingdom, which, according to our author, are *thirteen* in number, and are to be further arranged in five groups, viz., Thallophytes, Characeæ, Muscineæ, Vascular Cryptogams, and Phanerogams. Here the industry and care of the author are well shown, as he has collected from all trustworthy sources, descriptions of the structure and life-history of typical forms of plants. This classification is slightly modified in the appendix, which is taken from the fourth edition. The distinction between the Algæ and Fungi, namely, that the Algæ contain chlorophyll, while the Fungi do not, is disregarded, and the Algæ, Fungi, and Characeæ made into four classes, the characters being taken from the modes of sexual reproduction. It seems a pity that the division of the Vascular Cryptogams into classes was not reconsidered, as the discovery of the prothallium of Lycopodium breaks down the division into isoporous and heterosporous groups. We prefer a division of the vascular cryptogams into three classes: Filicinæ, Equisetaceæ, and Lycopodinæ. The Filicinæ include four orders—Filices, Marattiaceæ, Ophioglossaceæ, and Rhizocarpeæ—while the Lycopodinæ include three, viz., Lycopodiæ, Selaginellæ, and Isoeteæ. The chapter on the groups of flowerless plants are of great interest, and will be studied with pleasure by those who have only seen the meagre and often untrustworthy account given in some of our text-books.

Passing to the Phanerogams, Sachs considers the distinguishing characteristic of the group to be the formation of the seed. He contrasts the Cryptogams and Phanerogams, and points out the homologies of the reproductive organs. "This organ (the seed) is developed from the ovule, which, in its essential part, the nucleus, produces the embryo-sac, and in this the endosperm and the embryonic vesicle. The latter is fertilised by the pollen-tube, an outgrowth of the pollen-grain, and, after first growing into a pro-embryo, produces the embryo. The phanerogamic plant, which is differentiated into stem-leaves, roots, and hairs, corresponds to the spore-forming (asexual) generation of vascular cryptogams; the embryo-sac to the Macrospore: the pollen-grain to the Microspore: the endosperm is equivalent to the female prothallium; and the seed unites in itself, at least for a time, the two generations, the Prothallium (endosperm) together with the young plants of the second (sexual) generation (the embryo)." Throughout the whole of the chapters of the second book, the influence of the "Theory of Descent" is very evident. Sachs, however, withdraws, in the fourth edition, the pedigree of the vegetable kingdom, which he sketches in Book III. of the present edition. The Phanerogams are divided into three classes, Gymnosperms, Monocotyledons, and Dicotyledons. Our author adheres mainly to the Gymnospermous theory, and certainly the question whether conifers are gymnospermous or not has yet to be decided, notwithstanding the recent controversy of Eichler and Strasburger.

More than one hundred pages are devoted to the Angiosperms, Monocotyledons, and Dicotyledons. In the remarks on the flowers of Angiosperms, many of our long-cherished ideas, the arrangement of stamens, for example, are rudely disturbed. Monadelphous stamens, as in *Malvaceæ*, are shown to be the result of cohesion of primordial stamens, and subsequent branching. The Polyadelphous stamens of Hypericum are formed by branching of three or five primordial stamens. The use of the English terms "regular" and "symmetrical" as applied to flowers, has been a cause of trouble to the translators, and we cannot but express the hope that both these terms may be quietly dropped into oblivion. On the subject of placentation, the statements of Sachs differ from those usually taught in this country. He shows the relation between the parietal and axile forms, and, making two divisions—viz., the ovules produced by carpels, and the ovules produced on the axis—further subdivides both of these into two:—

1. Marginal. Ovules for reflexed margins of carpels.
2. Superficial. Ovules for whole inner surface of the carpel, except on midrib.
3. Lateral. Ovules produced singly or in numbers from floral axis.
4. Terminal. Apex of axis bearing nucleus of ovule.

The formation of the embryo is very carefully described from Hanstein's researches, and the three layers of tissue in the embryo, Dermatogen, Periblem, and Plerom, carefully figured. The great significance of these layers has probably not yet been fully appreciated, and if it holds that axial structures arise from plerom and lateral appendages from periblem tissues, then a most important guide will be obtained enabling us to determine accurately the morphological value of many disputed structures.

In the classification of inflorescences we have Schimper's term Dichasium substituted for the incorrect "dichotomous cyme" used in English works. This is a marked improvement, as it was always a difficulty to the student to find that, although called dichotomous, it was not so. There is also a great difficulty with the terms helicoid and scorpioid. Sachs uses Schimper's terms bostryx and cicinnus. De Candolle, in 1827, used the term scorpioid to distinguish the characteristic inflorescence of Myosotis, the scorpion grass. The recent researches of Kaufmann, Warming, and Kraus, show that the inflorescences of Borragineæ are sympodial arrangements of dichotomies; and we do not think there would be any difficulty in retaining the term scorpioid for them. Bostryx and cicinnus were used by Schimper in 1835, while it was not till 1837 that the brothers Bravais amended De Candolle's definition of scorpioid and introduced the term helicoid. Schimper's terms, therefore, have the priority, and ought to be used. (See Hofmeister's "Handbuch der Phys. Botanik," vol. i. p. 434).

The floral diagrams given by Sachs will be found very useful, and we also think that the adoption of the floral formulæ will be a great assistance to the student. Sachs uses the collective terms for the whorls throughout in his floral formulæ—calyx, corolla, androecium, and gynoecium, while the translators have substituted the name of the

individual member of each whorl, sepal, petal, stamen, carpel. This, we venture to think, is a mistake. We have now used for some time the contractions Ca. Co. An. Gn., which we prefer, the only objection being that this formula contains eight letters instead of five.

Many and great difficulties must have been encountered in translating the second book, and these difficulties seem to have been successfully overcome. We have no doubt that further experience will suggest changes and improvements even in the admirable book now before us.

The third book treats of Physiological Botany, and is divided into seven chapters. The first chapter is devoted to the molecular forces in the plant, and the second to the chemical processes in the plant. Naegeli's theory that organised bodies consist of isolated particles or molecules between which water penetrates is here fully described, and the value of the theory in explaining nutrition and growth by intussusception pointed out. The movements of water and gases in plants are also treated of in this chapter. The second chapter deals with the elementary constituents of the food of plants, assimilation and metatastasis, and respiration in plants. Sachs describes the separation of oxygen and fixation of carbon as assimilation, and limits the application of the term respiration to the taking up of oxygen and liberation of carbon dioxide. The influence of external conditions, as temperature, light, electricity, and gravitation in plants, forms the subject of the third chapter. The mechanical laws of growth, including the movements of growing parts, are fully described in chapter iv. This chapter will be read with much interest, and many of the statements will be found to be new to English students. The fifth chapter gives a careful *résumé* of what is known regarding the movements met with in full-grown parts of plants, whether periodic or dependent on the action of stimuli. Chapter vi. is devoted to the phenomena of sexual reproduction, the sections on the influence of relationship on sexual cells, and on hybridisation being of much importance. The last chapter is devoted to the origin of species, to varieties, and to the Theory of Descent.

In closing the book after giving the above brief sketch of its contents, we cannot but express our satisfaction at the manner in which Messrs. Bennett and Dyer have done their work. The notes appended to the English edition are of much value, and will assist the student in his studies. We have but one objection to the work, and that is its high price as compared with the German edition. Surely the price will be an obstacle in the way of its extensive circulation. Could anything be done to obviate this? Sachs himself has already issued the physiological portion of the third German edition separately. Why not permit students to obtain one or other of the three books separately? Or might not an abridgment be made, somewhat on the principle of Prantl's Lehrbuch? As a text-book it must exercise a most powerful influence on botanical teaching in this country, and while it will supersede all other text-books for advanced students, we fear that its size and price may prevent it being so widely used as it ought to be. With Sachs' text-book within reach, teachers and students will be themselves to blame if they are behind the time in botanical science. Then, the English edition being translated from the third German edition, students can readily keep up their knowledge, because the "Botanischer Jahresbericht," beginning as it does in 1873, will refer them to all the more recent literature. While we have thus expressed our entire satisfaction with the work of the translators and annotators, let us not forget to mention that the way in which the work is got up does credit both to the Clarendon Press and Messrs. Macmillan and Co.

W. R. M'NAB

DR. CHAMBERS'S "MANUAL OF DIET"

A Manual of Diet in Health and Disease. By T. King Chambers, M.D. (Smith, Elder, and Co., 1875.)

THERE are many writers who, immediately they place pen to paper, seem to be affected with a certain formality of diction and severity of style which prevents them doing justice to their subject in the eyes of the more easily satisfied public, who, while desiring instruction, prefer it to be mixed with a certain amount of that form of interest which can be given it by an apparent "at homeness" on the part of the author. Dr. Chambers does not suffer from this fault. In the work before us he has produced one of the most readable as well as practical manuals on diet which we could want to see. The interest is maintained from beginning to end, and much valuable information is given on many of the important topics of everyday life without the uncomfortable sensation of any effort being needed to obtain it.

The subject is treated of under three headings: General Dietetics, Special Dietetics of Health, and Dietetics in Sickness. The author commences with the question—What is the natural food of man Flesh-eating animals have teeth, jaws, and limbs suitable for capture and tearing, vegetable feeders have bulky viscera, and so on. Applying similar arguments to the human race, "to judge by form and structure alone, the natural food of an adult man must be pronounced to be *nothing*;" from which we must necessarily deduce, as is indicated by other considerations, that man as man assumed his special characters *after* he commenced the employment of instruments for offence and defence. In fact, the developed heel, with which is correlated the non-arboreal habit, is incompatible with the naturally defenceless condition of our species.

The space which is gained by the omission of the chapters on the chemistry, botany, &c., of food stuffs to be found in most works on diet and food, is, as we are told in the preface, employed in a full discussion of many matters connecting food and drink with the daily current of social life. The number of observations which will come home vividly to almost anyone turning over the pages of this work is so numerous that we think a few quotations will give the best idea of their scope. For instance, salads form an important article of diet in every family. "The salad ought to be dressed by one of the daughters of the house, after she has herself dressed for dinner, singing, if not with voice, with her clean, cool fingers, sharp silver knife, and wooden spoon—

> "Weaving spiders, come not here;
> Hence, you long-legged spinners, hence:
> Beetles black, approach not near;
> Worm nor snail, do no offence."

Since the introduction of railways the difficulty in procuring good mutton is acutely felt in all but large cities, and the author makes a suggestion which, where carried